

# INSTRUCTION MANUAL

Serial Number \_\_\_\_\_

## **5A18N DUAL-TRACE AMPLIFIER**



## WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

Any questions with respect to the warranty, mentioned above, should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type (or Part Number) and Serial or Model Number with all requests for parts or service.

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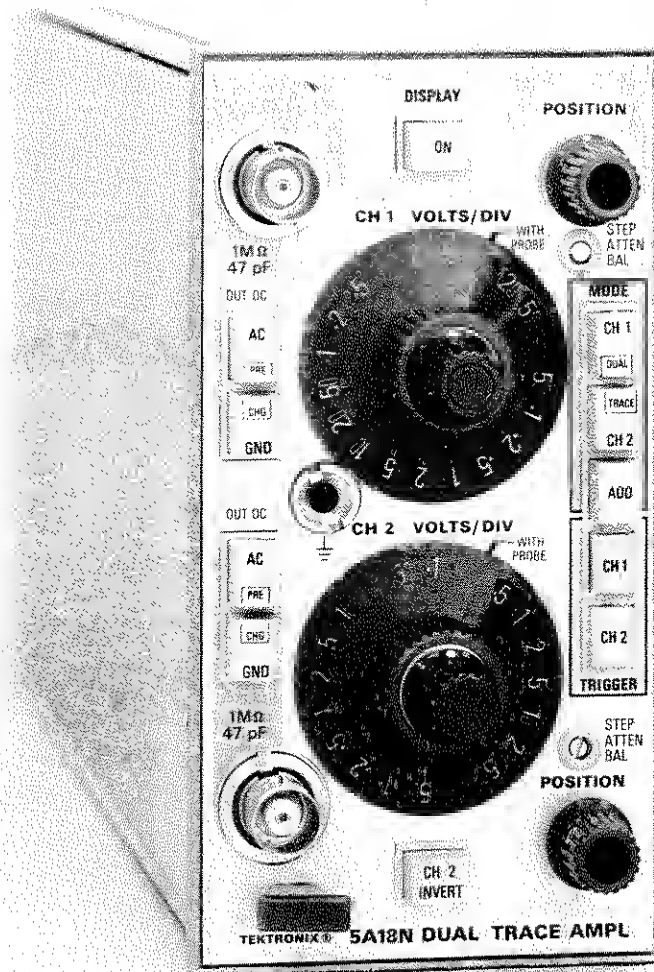


Fig. 1-1. 5A18N Dual Trace Amplifier.



# SECTION 1

## SPECIFICATION

*Change information, if any, affecting this section will be found at the rear of this manual.*

### Introduction

The 5A18N Dual-Trace Amplifier is a general-purpose dual-trace amplifier plug-in unit for use with Tektronix 5100-series oscilloscopes. The unit contains two independent amplifier channels with identical characteristics, and features solid-state circuitry and simplicity of front-panel controls. The VOLTS/DIV knob skirts are lighted to provide a direct readout of calibrated deflection factor. Either channel may be used to produce a single-channel display. Both channels may be used simultaneously to produce an algebraically added display, or the two channels may be electronically switched to produce dual-trace displays. Channel 2 invert allows a differential input. Each

channel has calibrated deflection factors from one millivolt per division to five volts per division and a bandwidth from DC to at least two megahertz. While designed primarily for use as a vertical amplifier, the unit can be operated in association with the horizontal deflection system of the oscilloscope for X-Y displays.

The following electrical characteristics apply over an ambient temperature range of 0°C to +50°C. Refer to the 5100-series Oscilloscope System manual for environmental characteristics.

In this manual the word Volts/Div or division refers to major graticule division.

TABLE 1-1  
ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Deflection Factor		
Calibrated Range	1 millivolt/division to 5 volts/division.	12 steps in a 1-2-5 sequence.
Accuracy	Within 2%.	Within 3% with P6060 probe.
Step Attenuator Balance		Adjustable for one division or less trace movement as VOLTS/DIV is rotated throughout its range.
Uncalibrated (Var) Range		At least 2.5:1.
Frequency Response		
Bandwidth (8 Div Reference)		
DC (Direct) Coupled	DC to at least 2 megahertz. (DC to at least 1.5 megahertz in ADD mode.)	
AC (Capacitive) Coupled	2 hertz or less to at least 2 megahertz. (2 hertz or less to at least 1.5 megahertz in ADD mode.)	
Step Response (Displayed)		
Aberrations	+2%, -2% or less, total of 3% or less of pulse amplitude.	

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Inputs		
Resistance	1 megohm, within 1%.	Time constant normalized for 47 micro-seconds.
Capacitance	≈47 picofarads.	
Maximum Safe Input Voltages		
DC (Direct) Coupled	350 volts (DC + peak AC).	
AC (Capacitive) Coupled	350 volts DC.	
Invert Trace Shift		Less than 3 divisions.
Position Range		At least + and — 10 divisions from graticule center.
Channel Isolation		
One Trace Displayed		0.1 division with an 8 division signal source or 50 dB, whichever is greater.
Two Traces Displayed		0.1 division with an 8 division signal source or 50 dB, whichever is greater.

# SECTION 2

## OPERATING INSTRUCTIONS

*Change information, if any, affecting this section will be found at the rear of this manual.*

### Introduction

The 5A18N Dual Trace Amplifier Plug-in operates with a Tektronix 5100-series oscilloscope. An understanding of the 5A18N operation and capabilities is essential for obtaining best results. This section of the manual gives a brief functional description of the front-panel controls and connectors, a familiarization procedure, and general operating information.

### PLUG-IN INSERTION AND REMOVAL

The 5A18N is calibrated and ready for use as it is received. It can be installed in any compartment of the 5100-series oscilloscope, but it is intended for use primarily in vertical compartments (the center and left compartments). For X-Y operation, the 5A18N may also be installed in the horizontal (right) compartment (refer to the 5100N Oscilloscope System Instruction Manual for information on X-Y operation).

#### NOTE

*If the oscilloscope system receives no DISPLAY ON logic levels from the vertical plug-ins, it is designed to display the unit in the left compartment.*

To install, align the upper and lower rails of the 5A18N with the plug-in compartment tracks and fully insert it (the plug-in panel must be flush with the oscilloscope panel). To remove, pull the release latch to disengage the 5A18N from the oscilloscope.

### CONTROLS AND CONNECTORS

This is a brief description of the function or operation of the front-panel controls and connectors. More detailed information is given under General Operating Information.

#### DISPLAY ON

Applies and removes logic levels to the oscilloscope system to enable or disable plug-in operation. The switch functions only when the plug-in is operated in one of the vertical plug-in compartments.

#### POSITION (CH 1 and CH 2)

Positions display.

#### VOLTS/DIV (CH 1 and CH 2)

Volts per major graticule division. Selects calibrated deflection factors from 1 mV/Div to 5 V/Div; 12 steps in a 1-2-5 sequence. Knob skirt is illuminated to indicate deflection factor. Readout is automatically scaled when readout-coded 10X probe is installed.

#### Variable Volts/Div (CH 1 and CH 2)

Provides uncalibrated, continuously variable deflection factor between calibrated steps; extends range to 12.5 V/Div.

#### STEP ATTEN BAL (CH 1 and CH 2)

Balances the input amplifier for least trace shift throughout the VOLTS/DIV gain-switching range.

#### Input Coupling Push-buttons (CH 1 and CH 2)

AC-DC: Button pushed in selects capacitive coupling of input signal; button out selects direct coupling of input signal.

GND: Disconnects the input signal and provides ground reference to the amplifier input stage.

PRE CHG: Both AC-DC and GND buttons pushed in allows pre-charging of the coupling capacitor. Refer to General Operating Information.

#### Input Connector (CH 1 and CH 2)

BNC connector for application of external voltage signals. Includes a coded-probe input ring for activation of X10 readout.

#### MODE Pushbuttons

CH 1: The Channel 1 signal is displayed.

CH 2: The Channel 2 signal is displayed.

DUAL TRACE: (both the CH 1 and CH 2 buttons pushed in): Permits dual-trace displays in

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**MODE Pushbuttons (cont)** either Alternate or Chop modes (selected at the time-base unit). In the Alternate mode, the display is switched at the end of each sweep. In the Chop mode, rapid switching between channels permits Channel 1 and 2 displays to be viewed simultaneously. Between-channel switching rates are determined by the oscilloscope mainframe.

**ADD:** Channel 1 and Channel 2 signals are algebraically added and the sum is displayed on the CRT.

**TRIGGER Pushbuttons** CH 1: Selects Channel 1 as the source of the internal triggering signal for the time-base unit.

CH 2: Selects Channel 2 as the source of the internal triggering signal for the time-base unit.

**CH 2 INVERT** Inverts the Channel 2 display when pushed in.

## BASIC OPERATION

### Preparation

The first few steps of the following procedure are intended to help quickly obtain a trace on the screen and prepare the instrument for immediate use. The remainder of the steps demonstrate some of the basic functions of the 5A18N. Operation of other instruments in the system are described in the instruction manuals for those units.

1. Insert the unit all the way into the oscilloscope system plug-in compartment.

2. turn the oscilloscope Intensity control fully counter-clockwise and turn the oscilloscope Power On. Preset the time-base and triggering controls for a 2-millisecond/division sweep rate and automatic triggering.

3. Set the 5A18N front-panel controls as follows:

DISPLAY	ON (deflection factor illuminated)
MODE	DUAL TRACE
TRIGGER	CH 1
CH 1 and CH 2	
POSITION	Midrange
VOLTS/DIV	.1 V Calibrated
STEP ATTEN BAL	Midrange
Input Coupling	DC, GND
CH 2 INVERT	Normal (button out)

4. Adjust the Intensity control for normal viewing of the two traces. The traces should appear near the graticule center.

5. Set the MODE to CH 1 and move the trace two divisions below the graticule centerline with the CH 1 POSITION control.

6. Apply a 400-millivolt peak-to-peak signal (available at the oscilloscope Calibrator loop) through a test lead or 1X probe to the CH 1 and CH 2 input connectors (use a T connector and patch cord as required).

7. Release the CH 1 GND pushbutton. The display should be square waves four divisions in amplitude, with the bottom of the display at the reference established in step 5. Adjust Trigger Level, if necessary, to attain a stable display. Rotate the Variable control throughout its range, observing a reduction of the display amplitude. Return the Variable control to the CAL detent (calibrated Volts/Div) position.

8. Set the MODE to DUAL TRACE and set both VOLTS/DIV switches to .2 V/Div. Release the CH 2 GND button and observe two square-wave displays, each two divisions in amplitude.

9. Push the CH 2 INVERT button to display the opposite polarity of the Channel 2 square wave. Return the display to its normal attitude by pushing and releasing the INVERT button.

10. Set the MODE to ADD. Note that the two displays algebraically add together, becoming a single square-wave display four divisions in amplitude. Verify the algebraic addition by pushing the CH 2 INVERT and observing a straight line as the two signals cancel each other.

11. Set the MODE switch to CH 1.

12. To demonstrate AC-coupled operation, re-position the display with the POSITION control to place the bottom of the display at the graticule centerline.

13. Push in the AC button and note that the display shifts downward about two divisions to its average level.

### Step Attenuator Balance (Both Channels)

If the STEP ATTEN BAL control is not properly adjusted, the CRT zero reference point (trace or spot) will



shift vertically due to differential DC imbalance in the amplifier as the VOLTS/DIV switch is rotated throughout its range. The shift is more noticeable on the most sensitive positions.

a. With the instrument operating, ground the input (GND button pushed in) and set the VOLTS/DIV switch to 5 V. Move the trace to the graticule center with the POSITION control.

b. Rotate the VOLTS/DIV switch throughout its range and adjust the STEP ATTEN BAL control for minimum trace shift.

### Gain Check (Both Channels)

The vertical and horizontal deflection systems of the 5100N-series oscilloscopes are gain-standardized to permit a plug-in to be moved from one oscilloscope to another (or from one compartment to another within the oscilloscope) without the need to recheck the calibration each time. However, the 5A18N gain can be checked and, if necessary, adjusted. Refer to calibration procedure, Section 4.

This completes the basic operating procedure for the 5A18N. Instrument operations not explained here or those that need further explanation are discussed under General Operating Information.

## GENERAL OPERATING INFORMATION

### Applying Signals

When measuring DC voltage, use the largest deflection factor (5 V/Div) when first connecting the 5A18N to an unknown voltage source. If the deflection is too small to make the measurement, switch to a lower deflection factor.

In general, probes offer the most convenient method of connecting a signal to the input of the 5A18N. Tektronix probes are shielded to prevent pickup of electrostatic interference. A 10X attenuator probe offers a high input impedance and allows the circuit under test to perform very close to normal operating conditions. The 5A18N is designed for compatibility with coded probes, such as the Tektronix P6060 and P6052 Passive Probes. The input connector has an outer ring to which the coding ring on the probe connector makes contact. This type of probe allows the vertical deflection factor indicated by the readout to correspond with the actual deflection factor at the probe tip, eliminating the need to consider the attenuation factor of the probe when measuring the signal amplitude on the graticule scale. See your Tektronix, Inc., catalog for characteristics and compatibility of probes for use with this system.

Sometimes unshielded test leads can be used to connect the 5A18N to a signal source, particularly when a high-level, low-frequency signal is monitored at a low-impedance point. However, when any of these factors is missing, it becomes increasingly important to use shielded signal cables. In all cases, the signal transporting leads should be kept as short as practical. Be sure to establish a common ground connection between the device under test and the 5A18N. The shield of a coaxial cable or ground strap of a signal probe provides an adequate common ground connection.

### Input Coupling

The AC-DC pushbutton switch allows a choice of input coupling. The type of display desired will determine the coupling used.

DC coupling (button out) can be used for most applications. However, if the DC component of the signal is much larger than the AC component, AC coupling (button in) will probably provide a better display. DC coupling should be used to display AC signals below about 2 hertz as they will be attenuated in the AC position.

In the AC position, the DC component is blocked by a capacitor in the input circuit. The low-frequency response in the AC position is about 2 hertz (−3 dB point). Therefore, some low-frequency attenuation can be expected near this frequency limit. Distortion will also appear in square waves which have low-frequency components.

The GND pushbutton provides a ground reference at the amplifier input. The signal applied to the input connector is presented with a one-megohm load, while the amplifier input is grounded. This eliminates the need to externally ground the input to establish a DC ground reference.

**Pre-charging.** To minimize surge currents in the circuit under test when using deflection factors of 50 mV/Div through 1 mV/Div and a test lead or 1X probe, use the AC-DC and GND pushbuttons to take advantage of the pre-charging circuit incorporated in the unit. The pre-charging circuit permits charging the coupling capacitor to the DC source voltage when the AC and GND buttons are pressed in, and also limits surge current to the coupling capacitor from the signal source. The procedure for using this circuit is as follows:

a. Before connecting the 5A18N to a signal containing a DC component, push in the AC and GND buttons. Then connect the input to the circuit under test.

b. Wait about one second for the coupling capacitor to charge.

c. Remove the ground from the coupling capacitor (GND button out). The display will remain on-screen and the AC component can be measured in the usual manner.

### Deflection Factor

The amount of trace deflection produced by a signal is determined by the signal amplitude, the attenuation factor (if any) of the probe, the setting of the VOLTS/DIV switch, and the setting of the Variable control. The deflection factors indicated by the VOLTS/DIV switch are calibrated only when the Variable control is rotated fully clockwise into the detent (CAL) position.

The range of the Variable control is at least 2.5:1. It provides uncalibrated deflection factors covering the full range between the fixed settings of the VOLTS/DIV switch. The control can be set to extend the deflection factor to at least 12.5 volts/division.

### Display Mode

**CH 1 or CH 2.** To display a single channel (single-trace operation), apply the signal to either the CH 1 or CH 2 input and set the MODE switch to either CH 1 or CH 2 to display the corresponding channel.

**DUAL TRACE.** To display both channels (dual-trace operation), push in both the CH 1 and CH 2 buttons.

**ADD.** The ADD button associated with the MODE switch is pressed to display the algebraic sum of two signals. The CH 2 INVERT button can be used in conjunction with

the ADD button to provide a differential input. Also, the ADD mode is used for DC offset (applying a DC voltage to one channel to offset the DC component of a signal on the other channel). The overall deflection factor in the Add Mode is difficult to determine from the CRT display. If both VOLTS/DIV switches are at the same setting, the deflection factor is that indicated by either switch. If the VOLTS/DIV switches are set to different deflection factors, the voltage amplitude of the resultant display is best determined if the amplitude of one of the input signals is known.

**CH 2 INVERT.** Pushing this button inverts the Channel 2 display; that is, the Channel 2 display is opposite in polarity to the Channel 1 display. Since the inversion occurs before the signal reaches the MODE switching, the CH 2 INVERT can be used in conjunction with the ADD button to remove an undesired common-mode signal.

### Trigger Source

The internal trigger signal for the time-base plug-in unit is obtained from either the Channel 1 or Channel 2 display. Select the trigger source by pushing either the CH 1 or CH 2 button.

### Oscilloscope Applications

Refer to the Operating Instructions section of the 5100N Oscilloscope System manual for basic oscilloscope applications, including peak-to-peak AC voltage measurements, instantaneous DC voltage measurements, comparison measurements, time-duration measurements, determining frequency, risetime measurements, X-Y measurements, etc.